



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

Address by
James E. Webb, Administrator
National Aeronautics and Space Administration

Dedication of Coordinated Science Laboratory Building
University of Illinois, Urbana, Ill.
Oct. 17, 1967

NASA AND THE UNIVERSITIES

My purpose in being here is to say that today is a historic moment in the life of this great university which for a century has played such an important role in education and in the growth of the Midwest.

To what was already a strong position of leadership in teaching and in research, particularly at the graduate level, you are adding new capabilities for coordinated multi-disciplinary approaches to your own chosen roles and missions, and to your efforts to relate these to Illinois and to the nation. Your handsome new Coordinated Science Laboratory building dedicated today is in large part a product of the space age which opened so dramatically just 10 years ago. I must say that NASA's contribution financially was very much less than that of this university, and the ability of the university to use this relatively small grant to produce a very large value is something that we, ourselves, feel proud of you for demonstrating.

Dr. Alpert, Dean of your Graduate College, is certainly one of those remarkable men whose foresight and know-how turns dreams into reality, utilizing the new forces of change so prevalent today to emphasize the continuing values of so much that is traditional and proven in our society.

You are fortunate on this campus that Dr. Compton is here as Director of this new laboratory. I think you're fortunate that the late Dr. Louis Ridenour as Dean of the Graduate College also had this kind of wisdom. As long ago as 1948, Dr. Ridenour pointed out that orbiting spacecraft were potentially an outgrowth of intercontinental ballistic missile development, and

N68-88197 (ACCESSION NUMBER)	(THRU)	None (CODE)	(CATEGORY)
	(PAGES)		
10	MX-61049 (NASA CR OR TNX OR AD NUMBER)		

FACILITY FORM 602

supported his statement with facts and figures on space trajectories and launch velocities. This, we must remember, was almost a decade before the space age began, and it illustrates one thing that professors do at universities like Illinois. They seek to translate new knowledge into generalized principles or concepts that give society the power of prediction.

Today most of us have grown accustomed to space accomplishments. These that we see every day would have seemed miraculous to even imaginative pioneers like Dr. Ridenour. For example, we accept almost as commonplace that as we meet here today the Mariner V spacecraft is drawing near our sister planet, Venus, on a journey that started more than four months ago.

Few of the millions who read newspapers or look at TV doubt that this highly instrumented unmanned explorer will fulfill its mission and fly within 2,500 miles of Venus' surface at about noon two days from now. As Mariner approaches Venus, these millions feel quite sure its scientific instruments will begin measuring the planet's magnetic field--if any--the charged particles and gases present in its upper atmosphere and its radiation level.

Through the openness of our space activity we have learned enough about space flight to take it for granted that Mariner's flight path will then curve behind Venus causing it to lose contact for a time with our tracking stations here on earth some 49 million miles away. Just before it goes behind the planet, however, it seems entirely reasonable to expect its radio signals to pass through the atmosphere of Venus, giving us an indication of its density, one of the prime objectives of this project.

Now, from this and other information that Mariner sends back, we expect--all who read the paper or look at TV expect--to obtain a great deal of new knowledge about our nearest planetary neighbor, and some of us expect this to add to our knowledge of the earth, itself, a sister planet of the Sun.

Let me describe briefly for you some of the technological problems that our U.S. space team has solved. Mariner weighs 540 pounds. It was catapulted from a launching platform, the earth, which is moving around the sun at 66,000 miles an hour. It was aimed so precisely that it will intercept a planet that is moving about 17,000 miles an hour faster than the earth, and this after a journey traversing a curving arc of 217 million miles and requiring more than four months' travel time. The flight path has been so precisely controlled over this long distance that the spacecraft will pass well within the atmosphere of Venus without being trapped and pulled into the surface by gravity. Along the way, Mariner was oriented so that its solar panels face the sun so that it could scavenge its power from space. It maintained antenna orientation to the earth, it corrected its attitude constantly, receiving, storing and executing commands sent to it from our ground stations. And, finally, it has to radio its findings back to earth.

There is much more that could be said. This remarkable scientific and engineering endeavor exemplifies the close cooperative working relationship between universities, industry, and the National Aeronautics and Space Administration laboratories. It is the work of a team that can provide assurance that our nation's needs in space can be met.

As in the past, the experiments carried on the Mariner spacecraft were conceived and built by university scientists. This has been true, Dean Alpert, from the earliest days of our program, and it represents opportunities to join researchers, teachers, and graduate students in real world projects--not out of this world projects--real world projects on the campus of their own university. We have formed no non-profit laboratories, although we fell heir to an outstanding one at the Jet Propulsion Laboratory.

We wish we could find more ways on the campus to associate graduate and postgraduate engineering education and research with the advanced engineering required to prepare scientific experiments for space flight such as those now on Mariner. By far the largest part of space science is done on the ground and it is our policy to support it on the university campus, not in government installations.

In my view, too many space scientists at universities insist on doing too much of their own engineering, and too few engineering education and research leaders have found ways to help them and to help themselves at the same time.

It has been scientific work closely associated with teaching at universities that, in many respects, has been the real generator of the spark that today makes space exploration a useful and meaningful endeavor.

At Cape Kennedy today, we are near the final stages of preparation for the first flight of the Saturn V rocket, carrying test articles of the Apollo command and service modules. The size of this giant rocket, as compared to Mariner, staggers the imagination. The first stage is powered by five engines which consume 15 tons per second of propellant as it lifts 6 million pounds from the earth and speeds the remaining poundage up to orbital speeds of 18,000 miles an hour. It can send to the moon 100,000 pounds, a little more than Columbus' flagship when he sailed to this continent. The samples that the Apollo system will bring back from the moon based on the power of this rocket will be examined, scientifically studied by 116 scientists concerned with this work all over the world, who have submitted projects that they, as scientists, believe to be important.

We are creating at the Houston Manned Spacecraft Center a lunar sample receiving laboratory with scientists working in close association with both astronauts and engineers and with the experts from the Fish and Wildlife Service, the Immigration Service, the Agriculture Department, because we have to be sure there is no back contamination of the earth from these first samples coming from another body in space. But we are also creating a laboratory home away from home for lunar scientists who can go to a building, not on a government installation, where they can have their own library, meeting rooms, control their activities, but walk across the street and talk to the astronauts who picked up the samples. And in connection with astronomy, one of the important flights to be made after the Apollo lunar landing is to place solar telescopes in orbit, to have them refueled and re-set by astronauts returning at some three months' intervals.

Now, this is the precursor of the system through which these orbiting telescopes for solar and astronomical work will be sent by vast telemetry systems to ground installations where the information will not be physical samples from the moon, but will be what astronomers have said they want returned from those telescopes, and we will follow the same policy of having a home laboratory away from home for the astronomers where they can walk across the street and look at the end of the telemetry link and take advantage of newly conceived ideas that come from the ongoing operation of the telescope, rather than to be limited to what they imagined they would like to have the telescopes find for them.

We are using astronomers in the Astronomy Mission Board through which we ask long-term planning for astronomers by astronomers and also pass the ongoing projects for funding through their hands so that they can examine, as a matter of feedback, what is being accomplished from month to month as projects go forward for approval in the governmental process.

This is a marriage of science and technology and governmental capability and management with the muscle built by industry that I believe forecasts good things for the solution of other very complex problems in our society.

Let me turn now back ten years almost to 1958. With the formation of the National Aeronautics and Space Administration, we began to get--I say "we," I was not there, I came in 1961--unsolicited proposals from university researchers in considerable volume. These researchers requested support for a wide variety of research effort, ranging from flight experiments and problems of immediate operational importance in the new space environment to long-range studies intended to extend the limits of existing fundamental knowledge in almost every discipline, and broaden the basic structure of research capabilities. It is important to note here that in 1958 the values of university, industry, and government cooperation had already been proven in the field of aeronautics through the development of an effective combination in the National Advisory Committee for Aeronautics which was formed in 1916. So there was a history in the area of aeronautics on which a sound structure was built to combine aeronautical and space research.

During NASA's first year of operation, approximately 3 million dollars was invested in research at universities, along with an equal amount of non-profit institutions and in industry. The second year, approximately \$6 million went to universities, and the third year about \$14 million. During these early years, most of this university research support aimed at the solution of immediate problems, although there were several outstanding examples of broad fundamental effort. Six years ago, when President Kennedy and Vice-President Johnson set our sights on broader goals in aeronautics and space, some of us at NASA became concerned that not enough basic research was being undertaken to lay the groundwork for the kind of space flight experiments that would be available in the years ahead, which seemed to offer the greatest value. At the same time, we were concerned that the universities were not producing enough trained qualified men and women in the various scientific fields. Every component of NASA was told to take stock of its strengths and weaknesses, to examine its policies and procedures, and reevaluate its available resources.

A critical appraisal of NASA-university relationships revealed in 1961 a number of facts:

...First, the universities are already contributing significantly to the national space program through sponsored project research;

...Second, this pattern of project research alone could not adequately satisfy the nation's needs in space;

...Third, many universities were able and anxious to do more, but were constrained by the pattern of existing programs and apprehensive of expanded project type effort which might undermine the institution's internal balance;

...Fourth, no other federal agency was moving to utilize this existing capability; and,

... Fifth, NASA could develop techniques which would improve the ability of universities to perform their own unique and traditional functions and still respond to NASA's new needs.

Dr. Hugh Dryden, Dr. Robert Seamans, Dr. Homer Newell and I studied these facts. We approved the calling together of 16 of the nation's best university people who met with an equal number of NASA representatives to examine ways and means to strengthen NASA-University relationships and to expand research on the campus. We met with them for a vigorous personal interchange, and pointed out that our purpose was to strengthen the universities as institutions and that any program devised should make sure that the full range of needs, as seen by university leaders, those concerned with the quality of teaching as well as the needs of research, would be heard.

Our panel of experts felt in 1961 that a program could be developed through which NASA could expand its support of university research to the advantage of all concerned. However, they felt it was not NASA's business, but must be up to the universities to develop good graduate programs and to turn out well-qualified persons who would merit additional government support.

The panel agreed that NASA should exert every effort to encourage conditions conducive to broadly based research within the university community, and to do so over a widespread geographic basis throughout the country. The suggestions of this panel of experts were essentially as follows:

...First, establish NASA-university research centers;

...Second, supply universities with buildings and other hard-to-finance facilities;

...Third, establish 4,000 to 5,000 fellowships;

...Fourth, encourage the larger universities to aid the small ones;

...Fifth, bolster high school interest in the space science and the study of basic science and mathematics;

...Sixth, extend support to the social sciences;

...Seventh, establish an appropriate NASA headquarters organization to conduct university and educational programs, and,

...Eighth, issue an open report on the NASA-university discussion.

Most, if not all, of these suggestions were eventually put into practice, as you here at the University of Illinois are well aware through your own active participation. We expanded our support of research, we helped construct facilities, we established graduate fellowships. The program built up to a peak reached about a year ago to some 10,600 campus persons who were involved. This number is now diminished. Our prime need in 1961 was expansion, to interest a small number of experienced scholars to expose large numbers of new young talent to opportunities in space research and to expand the facilities within which they could work on university campuses.

Today the situation is changed. The need is to reduce expenditures for research, to preserve at minimum cost to essential strength needed for the future, and to increase the multi-disciplinary flux that will magnify the values the nation can derive from the activities we can support. On this campus you know this means not just science and technology, but other disciplines as well.

Let me ask: How can university research expenditures be reduced without major dislocation? Fortunately, we have used step funding on a three-year cycle in a number of areas. This will help, but the problems are still extremely difficult. We're taking such steps as we can to ease the impact on universities and conserve our hard-won gains. First of all, we have set up a special task force to evaluate all our relationships with the academic community and to come up with specific recommendations as to least harmful methods we can use. There is no longer any doubt that NASA's university support programs will have to be redefined quite drastically in some areas.

We are moving toward support of experiments at several universities that emphasize multi-disciplinary team efforts which combine science and technology with all available and related other disciplines in policy studies which attempt to use selected feedback from program executions to test assumptions. We have recently arranged with several universities to support experiments in engineering team research in graduate teaching, based on an advanced design of some new system such as the radar for use on the moon. We have undertaken similar support for

experiments in graduate schools of public administration, related to new management concepts required for success in large scale development of efforts such as Apollo and the supersonic commercial transport. We are asking the National Academy of Engineering and the newly formed National Academy of Public Administration to follow these closely, just as the National Academy of Sciences follows our experiments with universities in the disciplines of science.

Now, under our system of step funding, even with heavy cutbacks and even with these more appropriate introductions of new programs, even though the total is declining, the budget for this year does mean that with step funding the major effect--that is, the cutbacks in the budget this year with step funding means that the effect will be spread out over a longer period than one year. Some programs can continue at steadily reducing levels for perhaps several years. Graduate fellows can complete the work for their Ph.D.'s even if new training grants are sharply reduced or cut off entirely. In whatever we face, we earnestly hope you will continue to help us press for increased multi-disciplinary involvement on the campus.

In this nation at this time, I believe we must continue to ask if the compartmented or semi-compartmented way of the past is good enough, either for the individual scholar or for the universities. My own belief is that the university must seek and find ways that make for better research decisions and wider involvement by all appropriate disciplines. These ways need to take better account of the long lead times and, consequently, the long commitment increasingly required in advanced areas of science. I believe that this kind of activity in this period of declining support can lay the base for more valuable work in the future and, for the selection of projects to be funded in the future which will yield greater value than we could have otherwise.

It seems to me that universities under these conditions can use the requirements of the new larger scientific systems to bring to bear all or much of the disciplines that can contribute to the research that is permitted to continue and without some of the pressures of the last five years. I do not mean to say by this that NASA does not place a high value on the work of individual scholars in individual disciplines. They have been responsible for the great bulk of scientific progress to date. But today's problems, it seems to me, are growing increasingly complex, and education, like other aspects of modern society,

must find a way to respond to the need for contributions to solutions from many groups and many disciplines.

We are at a time of challenge when universities must seek to develop broad ranging minds capable of new and original thinking about all factors that underlie the human and social problems of today. The kind of brainpower that can guide and control spacecraft to fly within 2,500 miles of the planet Venus should certainly be able to apply much of the same kind of innovative thinking to many problems here on earth, such as air and water pollution, disease, hunger, housing, transportation, and crime control. We have developed a pattern in the National Aeronautics and Space Administration that has given success in developing three generations, and in some cases four generations, of spacecraft in less than a decade. This may offer some promise with respect to approaches to other complex problems.

Many thoughtful students of today's world believe that universities owe it to themselves to find ways of re-examining their internal structures, attitudes and activities against a new background. And in today's diminishing support for higher education, at least in relative terms, it seems to me that industrial leaders will pay a good deal more attention to making investments in tenure professorships, aimed at basic research if the university approaches this problem from the standpoint of seeking this as an investment rather than as a charitable gift. The development of a few university teams working together across the traditional disciplines, combining the best efforts of technology, the social sciences and management capability which they have created and which make them the best available source of trusted information in our society can write a new chapter of history of problem solving in this nation. And the fundamental research which, alone, will enable others in years to come to solve their problems can be facilitated and expanded in the process.

In far too many fields, ladies and gentlemen, the future is coming on us faster than the past is retreating. I'm here today to express a strong belief that in all of this the University of Illinois stands in a position to be a leading participant.